The Royal College of Surgeons of England

Ann R Coll Surg Engl 2004; **86**: 260–262
doi 10.1308/147870804551

Original article

A safe, simple and cost-effective protocol for blood transfusion in primary total knee replacement

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Background: **Patients undergoing total knee replacement (TKR) in the UK usually have either blood cross-matched or have an auto-transfusion of drained blood postoperatively. A previous retrospective audit of blood requirements in patients who had undergone primary TKR showed that a large amount of cross-matched blood was wasted as the CT ratio (ratio of number of units of blood cross-matched to number of units transfused) of 4.9:1 was obtained. The range recommended by the Blood Transfusion Society is 2:1 to 3:1.**

Methods**: A protocol was introduced to group and save plus antibody screen for all patients and to cross-match 2 units of blood pre-operatively in patients with either a haemoglobin of less than 12.5 g/dl or with multiple red cell antibodies in their blood. The trigger point for blood transfusion postoperatively was also reduced from 9.0 g/dl to 8.0 g/dl, unless the patient was clinically symptomatic.**

Results: **A further prospective study involving 50 patients was carried out using the new protocol. Five patients required cross-matching pre-operatively, three with haemoglobin less than 12.5 g/dl and two with multiple red cell antibodies. Postoperatively, the patients with haemoglobin of less than 12.5 g/dl required blood transfusion of 2 units each, reducing the CT ratio to 1.7:1. The patients with red cell antibodies did not require a blood transfusion.**

Conclusions**: The benefits from above protocol are 2-fold: patient safety, as risks of transfusion are avoided; and cost saving, in regards to haematology technician time and auto-transfusion sets which cost around £70 each.**

Key words: Total knee replacement – Group and save – Cross-match – Cross-match transfusion (C/T) ratio

Total knee replacement (TKR) is commonly performed in the UK and blood transfusion protocols vary throughout the country. A telephone survey in October 2000 revealed that 65% (10 of 16) major hospitals in Wales cross-match 2 or more units of blood pre-operatively for all patients undergoing primary total knee replacement. A previous audit in February 2000 at our hospital showed a cross-match transfusion (C/T) ratio of 4.9:1. This meant that 77% of cross-matched blood was not used, resulting in wasted blood due to it reaching its expiry date, and an increased workload for the blood transfusion department.

The aim of this study was to demonstrate the benefits of a simple blood transfusion protocol in primary total knee replacement.

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Patients and Methods

In this prospective study, we looked at 50 patients undergoing primary TKR. The male to female ratio was 20:30. The mean age was 68 years (range, 50–85 years).

The indication for TKR was osteoarthritis in all the 50 patients. All patients had a group and save and an antibody screen. None of the patients had a previous history of transfusion.

The mean pre-operative haemoglobin in the males was 14.6 g/dl (range, 13.1–16.4 g/dl) and in the females was 13.5 g/dl (range, 10.4–15.3 g/dl). Five patients were on aspirin for medical reasons and five on voltarol for pain. Two of these ten patients were taking both the medications. As per the department's protocol, patients continued to have the medications during the peri-operative period. None of the 50 patients in our study group had a previous history of thrombosis and/or embolism and hence were not given prophylactic anticoagulation. TED stockings and calf pumps were used in all patients.

Following a previous retrospective audit, a protocol was developed to group and save plus antibody screen for all patients and to cross-match 2 units of blood pre-operatively in patients with either a haemoglobin of less than 12.5 g/dl or with multiple red cell antibodies in their blood, as compatible blood with antibodies is not available at short notice.

Using the above protocol, five patients required pre-operative cross-matching, three with a haemoglobin of below 12.5 g/dl (10.4, 10.6, and 11.9 g/dl) and two patients with multiple red cell antibodies in their blood.

All the knee replacements were performed using a tourniquet by five different surgical teams. Different types of prosthesis namely LCS, PFC and Next gen were implanted with cement. Suction drains were used in all patients. In all the cases, the tourniquet was released after the wound was closed. A check haemoglobin was performed 24 h postoperatively. Patients with a post-operative haemoglobin between 8.0 g/dl and 10.0 g/dl were treated with ferrous sulphate and were considered for a blood transfusion only if clinically symptomatic.

Results

Forty-seven patients did not require a blood transfusion postoperatively. The three patients who required blood transfusion had pre-operative haemoglobin of less than 12.5 g/dl. Two of these patients had postoperative haemoglobin of 8.1 g/dl but were clinically symptomatic. The mean postoperative haemoglobin for these three patients was 8.0 g/dl (range, 7.9–8.1 g/dl).

The mean postoperative haemoglobin in males was 11.4 g/dl (range, 9.7–14.0 g/dl) and in females was 11.1 g/dl (range, 7.9–13.9 g/dl) with a combined mean of 11.2 g/dl. The average drop in haemoglobin was 2.9 g/dl.

There was a reduction in the postoperative blood transfusion requirement from 33% in the retrospective study to 6% in the prospective study using the new protocol.

Discussion

Up to 50,000 total knee replacements are performed in the UK every year.[1] The blood transfusion protocols vary throughout the country. The blood transfusion society recommends use of cross-match/transfusion (C/T) ratio in determining transfusion requirements for primary TKR. This is the ratio of number of units of blood cross-matched to the number of units transfused (recommended range, 2:1 to 3:1 with 1:1 being the ideal).[2]

A retrospective audit in our hospital involving 85 patients showed a CT ratio of 4.9:1. This showed that cross-matched blood was not being routinely transfused. Following the audit, a protocol was introduced to group and save plus antibody screen for all patients and to cross-match 2 units of blood pre-operatively in patients with either a haemoglobin of less than 12.5 g/dl or with multiple red cell antibodies in their blood. The trigger point for blood transfusion postoperatively was also reduced from 9.0 g/dl to 8.0 g/dl, which lead to reduction in the postoperative blood transfusion requirement from 33% in the retrospective study to 6% in the prospective study. The patients with a postoperative haemoglobin of between 8.0 g/dl and 10.0 g/dl were treated with ferrous sulphate and considered for a blood transfusion only if found to be clinically symptomatic.

In the prospective study using the above protocol, 2 units each of blood was cross-matched for 5 patients pre-operatively, three patients had haemoglobin below 12.5 g/dl pre-operatively and two had multiple red cell antibodies.

The three patients with a pre-operative haemoglobin less than 12.5 g/dl required blood transfusion post-operatively. Patients with antibodies had pre-operative haemoglobin of greater than 13.0 g/dl and did not require any transfusion. Out of the 10 units of blood cross-matched, 6 units were transfused giving a CT ratio of 1.7:1 (10/6) which was within the normal range.

The benefits from the above protocol were 2-fold: Patient safety as the risks of transfusion were avoided and cost saving in regards to the haematology technician time and auto-transfusion sets which cost around £70 each.

Patients on aspirin and/or NSAIDs had pre-operative haemoglobin of greater than 12.5 g/dl and did not require any transfusion postoperatively.

Several studies have addressed blood transfusion requirements in the total joint arthroplasty of hips and knees, but few have utilised guidelines estimating C/T

ratio as recommended by the blood transfusion society.[3–5] Also, a reduction in the trigger point for blood transfusion from 10.0 g/dl to 8.0 g/dl has reduced transfusion requirements.[6]

Different blood transfusion techniques namely allogenic and autologous have been looked at and recommended, but are costly and not without complications.[7–10] A cost-benefit analysis using control trial would give more robust evidence.

In our study, it is difficult to say whether or not the use of a cell salvage system may have prevented blood transfusion in the patients with pre-operative haemoglobin of less than 12.5 g/dl. It may be beneficial to perform a randomised trial in patients with pre-operative haemoglobin of less than 12.5 g/dl, using a cell salvage system in one group and not in the other.

Although none of the patients in our study bled profusely postoperatively, a theoretical risk of such a situation cannot be ruled out. Hence, we advise a low threshold should be maintained for patients with massive blood loss postoperatively and cross-matched blood requested urgently.

Conclusions

We conclude that a group and save and antibody screen is sufficient for patients with a pre-operative haemoglobin of 12.5 g/dl and above undergoing primary TKR. Two units of blood should be cross-matched pre-operatively for patients with either a pre-operative haemoglobin of less than 12.5 g/dl or with multiple red cell antibodies in their blood, as compatible blood with antibodies is not available at a short notice.

Acknowledgement

We thank Mrs Pamela Yandell, Blood Bank, Royal Glamorgan Hospital, South Wales for her help.

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